DOCUMENT RESUME

ED 215 318 CS 006 614

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TITLE Metaphor Comprehension and Cognitive Effort.
PUB DATE Apr 81
NOTE 13p.; Paper presented at the Annual Meeting of the Eastern Psychological Association (52nd, New York, NY, April 22-25, 1981).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Processes; College Students; Higher Education; *Language Processing; *Metaphors; *Reading Comprehension; Reading Processes; *Reading Research; Sentences; *Short Term Memory

ABSTRACT

A study investigated processing differences between metaphorical and literal versions of the same sentences. The purposes of the study were (1) to directly compare the on-line processing demands of metaphoric and nonmetaphoric sentences, and (2) to examine the consequences of such sentences for memory performance. The subjects were 39 college students who were shown 48 pairs of sentences, one a stimulus sentence and one a correct or incorrect paraphrase used as a verification task. A secondary task was used to measure the amount of cognitive capacity expended during sentence comprehension; on half of a subject's trials a brief click was presented through headphones while the subject was processing the verification-task sentence. The results showed that more cognitive effort was required for analyzing the meaning of a metaphor than for a literal sentence. The recognition data also showed that a sentence was remembered better when the meaning was conveyed metaphorically. Overall, the results suggested that different types of processing are involved in understanding literal and figurative language, supporting the idea that the amount of cognitive effort expended during comprehension is significantly related to memory performance. (RL)

Metaphor Comprehension and Cognitive Effort

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Paper presented at the 52nd annual meeting of the Eastern Psychological Association, New York, N.Y., 1981.

Metaphor Comprehension and Cognitive Effort.

In recent years, psychologists have begun to recognize the important role that metaphors play in cognition. For instance, several conferences and symposia have taken place which have dealt entirely with the topic of metaphors. One focus of this increase interest in metaphors has been the examination of the comprehension of figurative language. For example, previous researchers have investigated the ability of subjects to produce metaphoric sentences (Pickens & Pollio, 1979), memory for metaphors and nonmetaphors (Bock & Brewer, 1980), and the effect of context on metaphor comprehension (Ortony, 1978). However, the differences which may exist between the processing of literal and figurative language have not been extensively investigated. Little is known about the internal cognitive processes (e.g., attentional capacity, internal representational format) that might be involved in metaphor comprehension.

The majority of studies which have previously suggested that differences may exist between the processing of metaphor and nonmetaphors have based their conclusions upon differential recall of metaphors and literal sentences (Bock & Brewer, 1980; Harris, 1979). In an attempt to examine these suggested processing differences more closely, Harris, Lahey, & Marsalek (1980) attempted to interfere with the initial processing of metaphoric and literal sentences.

Harris reasoned that if metaphors do require more attention or elaborative processing than literal sentences, then interfering with their initial processing should make the metaphors more difficult to remember. The results showed that both sentence types were remembered equally well, even under fairly heavy attentional demands.

Although Harris' study asked an important question about the amount of cognitive processing needed to understand a metaphor, his methodology was not sensitive to on-line processing differences. In addition, previous research has failed to ensure that the sentences which were presented to the subjects were in fact comprehended. Finally, it is possible that previous differences which have been found between the recall of metaphors and literal sentences may be accounted for by the amount of cognitive effort required for their comprehension as suggested by Tyler, Hertel, McCallum, & Ellis (1979).

One important aspect of on-line processing is the amount of cognitive capacity or mental effort used during the comprehension process. Models of cognitive effort such as Kahneman's (1973) are based on the assumption that humans possess a limited capacity central processor and that two signals which require simultaneous processing will compete with each other for this central capacity. The secondary task procedure is frequently used to measure the amount of cognitive effort expended during sentence comprehension. According to the logic of this procedure, the more cognitive

capacity required by a primary task, the less will be available for a secondary task, producing a longer latency for response to the secondary task.

The present study was designed to investigate on-line processing differences between metaphorical and literal versions of the same sentences using a secondary task procedure. Verification of the meaning of metaphors and nonmetaphors was the primary task and response to an intermittent click signal was the secondary task. The purposes of this study were: 1) to compare processing demands for figurative and literal language during the comprehension process, and 2) to examine the consequences of such differences on verification and memory performance.

Methods

Subjects:

The subjects were 39 undergraduate psychology students who received course credit for their participation in the study. All subjects were native speakers of English.

Procedure

The stimuli were 48 pairs of sentences constructed by Harris (1976). Each set consisted of two sentences which expressed the same idea in either metaphorical or nonmetaphorical form. The sentences were equated for

syntactic structure and meaning. For example, "The old couch was in love with its new slip cover" (metaphorical) and "The old couch looked good in its new slip cover" (literal) both express the same meaning. A brief paraphrase was constructed for each set for use in the verification task (e.g., "The new slip cover improved the appearance of the couch"). For half of the sentences of each type the paraphrases were correct and for the remaining half they were incorrect.

The subjects were shown a total of 48 pairs of slides, in an individual testing session. On each trial, the first slide contained one version of a stimulus sentence, followed after 6 seconds by a second slide containing a paraphrase of the sentence for verification. On half of the trials a brief click was also presented through headphones approximately 250 msec after onset of the test slide, i.e., while the subject was processing the sentence. Subjects were instructed to respond to the click by pressing a button as rapidly as possible, but told that they should focus on the primary task of verifying the stimulus and test sentence. Two digital timers were used to record the button-press response latencies to the clicks (secondary task) and the verification of the test sentence (primary task) on each trial. Sentence type (metaphor or nonmetaphor) was balanced across subjects, for a given sentence.

Following presentation of the sentence pairs, the

subjects were given a forced-choice recognition test. Each test pair consisted of the metaphorical and literal versions of a given sentence. The subject's task was to indicate which version of that sentence had been presented earlier.

Results

Performance on the primary (verification) task indicated that subjects comprehended both types of stimulus sentences equally well. The verification latency data showed the usual advantage for positive verification responses ($p<.01$), but no differences attributable to sentence type. Mean latencies for correct paraphrases were 3.42 sec for metaphors and 3.48 sec for nonmetaphors. On the secondary (click) task, the mean response latency was 141 msec for metaphors and 118 msec for nonmetaphors, indicating that relatively more of the available cognitive capacity was used during the comprehension of metaphors. This difference was highly significant ($p<.001$). The probability of correct recognition memory was also greater for the metaphorical stimulus sentences than for their literal counterparts ($p<.01$), and greater for sentences requiring a positive verification response ($p<.03$).

Discussion

The results of the present study demonstrated that whether a sentence is presented in a literal or figurative form had significant effects on sentence processing. When a metaphorical sentence was presented, more cognitive effort

was required for analyzing its meaning than for a literal version of the same sentence. When subjects are forced to comprehend meaning, however, they can verify a paraphrase of either type of sentence with equal speed and accuracy, suggesting equivalent comprehension. The recognition data showed that a sentence was remembered better when the meaning was conveyed metaphorically than when it was conveyed literally. The fact that subjects used more cognitive capacity during the comprehension of metaphors was associated with better memory for the metaphors. These findings suggest that figurative and literal language have different implications for language processing. They also support the prediction of Tyler et al. (1979) that the amount of cognitive effort expended during processing is related to memory performance.

Previous arguments for differences between the processing of metaphors and nonmetaphors have been based almost entirely on the finding of observed memory differences between the two types of sentences (Bock & Brewer, 1980; Harris, 1979). Through the use of the secondary task technique, the present study has demonstrated that there are also differences in the on-line processing of metaphors and nonmetaphors. Specifically, the amount of attention used during comprehension was greater for metaphors. This difference in attention was reflected in the slower reaction times to the secondary task signal presented during the primary task of comprehension.

An important question remains: Why does the comprehension of a metaphor require more cognitive effort than that of a literal sentence? This finding suggests that the comprehension of literal and figurative language may involve different underlying processes, as implied by Bock & Brewer (1980) and Black (1979). Although the present data do not allow us to determine the exact nature of the processing differences, it is possible to offer some speculations. One possible explanation might be related to the use of inferences during the comprehension of metaphors. A metaphor is a type of implicit statement which forces the subject to go beyond what is explicitly or literally stated in order to construct the meaning of the sentence. The increase in effort for metaphors may be related to the added operation of drawing an inference during the comprehension process. Metaphors are also probabilistic in nature, in that they may not necessarily have one correct meaning, as directly asserted literal statements usually do. The probabilistic nature of metaphors may cause the subject to use more cognitive effort during comprehension.

The increase in effort which occurred during the processing of metaphors may also be related to the use of imagery. For instance, Harris, Lahey, & Marsalek (1980) found that although metaphors were rated as more difficult to image than nonmetaphors, subjects reported using imagery more frequently during the processing of metaphors. The use of a different secondary task procedure might provide

further insight into the use of imagery during the comprehension of metaphors. For example, a visual secondary task signal could be substituted for the auditory probe signal which was used in the current study. If imagery is involved in metaphor comprehension, then it might be predicted that a visual secondary task probe would cause modality-specific interference and thus produce slower reaction times during the processing of metaphors than would an auditory task probe.

Furthermore, if cognitive effort is significantly related to the recognition of metaphors, equating the amount of effort needed to understand literal and metaphoric sentences should erase the memory advantages found for metaphors in the present study. Previous research (Ortony, 1978; Tanhauser, 1978) has shown that the ease with which a sentence is processed is determined by its preceding context. When a metaphor is preceded by a relevant context, the metaphor takes no longer to understand than a literal sentence. One might predict that embedding each metaphoric sentence in the present study in an appropriate context should equate the amount of effort required to understand both types of sentences. If the cognitive effort hypothesis is correct, then metaphoric and nonmetaphoric sentences would be recalled equally well under contextual conditions. This would provide further support for the importance of cognitive effort as a predictor of memorial functioning.

In summary, the results of the present study

demonstrated that whether a sentence was literal or figurative had a significant effect on sentence processing. It was found that when a metaphorical sentence was presented, subjects used more cognitive effort in analyzing its meaning. The results also showed that when the meaning of a sentence was conveyed metaphorically, it was remembered better than when it was conveyed literally. Thus, the fact that a subject used more cognitive effort during the comprehension of metaphors was associated with increased memory for the metaphors. Future research on sentence processing should focus on further delineation of the differences which occur during the processing of figurative and literal language.

In the past, the goal of linguistics has been to understand the relationship between the explicit linguistic structure of a sentence and its meaning. The current results, however, suggest that this goal is only achievable if we also understand how the meaning of a sentence is affected by factors other than its explicit linguistic structure. Thus, the study of metaphors will increase not only our knowledge of figurative language processing but may also lead to a more complete and general understanding of language processing.

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